

CLAIMS

What is claimed is:

1. A pipe or tubing of crosslinked polyethylene ("PEX") having a wall of substantially uniform thickness in the range from 1.78 mm to 17.29 mm having dispersed therein less than 2% by weight of carbon black having a particle size less than 27 nm (nanometers).

2. The pipe of claim 1 wherein the carbon black is present in an amount in the range from 0.1% to 1.75% by wt. in the PEX.

3. The pipe of claim 1 wherein the carbon black is present in an amount in the range from 0.25% to 1.5% by wt. in the PEX.

4. The pipe of claim 1 wherein the carbon black is present in an amount in the range from 0.4% to 1.25% by wt. in the PEX.

5. The pipe of claim 1 including,
an inner tubular core of protective polymer selected from the group consisting of high density polyethylene ("HDPE") and chlorinated polyethylene ("CPE") contiguous with the inner surface of the crosslinked PEX, the core having a substantially uniform wall thickness in the range from 0.025 mm (1 mil) to 1.52 mm (0.06"), and a maximum wall thickness in the range from about 28 to 100 times smaller than the nominal diameter of the pipe in the range from 7 mm (0.25") to 152 mm (6"), ratio 28 being attributable to small diameter non-SDR-9 piping, and ratio 100 being attributable to the larger diameter SDR-9 pipe, wherein the HDPE has a density in the range from 0.941 g/cc to 0.963 g/cc, and the chlorinated PE has a chlorine content in the range from 5 to about 50% by weight.

6. The pipe of claim 5 wherein the HDPE has a density in the range from about 0.950 to about 0.963 g/cm³ and the PEX is crosslinked to a gel level of at least 65%.

5 7. The pipe of claim 5 wherein the inner core has a wall thickness in the range from at least 0.025 mm (1 mil) to about 1.52 mm (0.06") thick for pipe having a nominal diameter in the range from 7 mm (0.25") to 152 mm (6").

10 8. The pipe of claim 7 wherein the inner core has a wall thickness in the range from about 0.05 mm (2 mil) to 0.1 mm (4 mils) for pipe having a nominal diameter in the range from 13 mm (0.5") to 25 mm (1") and the gel level of PEX is greater than 70%.

15 9. The pipe of claim 2 wherein the PEX is crosslinked by a method chosen from the addition of peroxide, the addition of AZO compounds, and silane grafting process.

20 10. The pipe of claim 9 wherein the silane grafting process is selected from the Sioplas process or Monosil process.

 11. The pipe of claim 2 including successive inner and outer contiguous layers of PEX melt-bonded to one and another, the inner layer containing carbon black, and the outer layer being PEX free of carbon black and color-coded.

25 12. A tri-layered PEX pipe comprising:
 (a) an inner tubular core of protective polymer having a substantially uniform wall thickness at least 0.025 mm but no more than 1.52 mm, the protective polymer contiguous with the inner surface of the crosslinked PEX, the core having a substantially uniform wall thickness in the range from 0.025 mm (1 mil) to 1.52 mm (0.06"), and a maximum wall thickness in the range from about 28 to 100 times smaller
30 than the nominal diameter of the pipe in the range from 7 mm (0.25") to 152 mm (6"),

ratio 28 being attributable to small diameter non-SDR-9 piping, and ratio 100 being attributable to the larger diameter SDR-9 pipe, wherein the protective polymer is coextrudable with the PEX;

(b) an intermediate tubular layer of crosslinked polyethylene (PEX) having a gel level of at least 65% and containing from 0.1% to about 1.75% by weight carbon black, the intermediate tubular layer contiguously disposed radially outward from the core; and,

(c) an outer tubular layer of PEX free of carbon black, having a gel level of at least 65%, wherein said outer tubular layer of PEX is color-coded for installation in a chosen service.

13. The tri-layered pipe of claim 12 wherein the protective polymer is selected from the group consisting of high density polyethylene ("HDPE") and chlorinated polyethylene ("PE"), the HDPE has a density in the range from 0.941 g/cc to 0.963 g/cc, and the chlorinated PE has a chlorine content in the range from 5 to about 50% by weight.

14. A multilayer pipe comprising:

(a) an inner tubular core of protective polymer having a substantially uniform wall thickness at least 0.025 mm but no more than 1.52 mm, the protective polymer contiguous with the inner surface of the crosslinked PEX, the core having a substantially uniform wall thickness in the range from 0.025 mm (1 mil) to 1.52 mm (0.06"), and a maximum wall thickness in the range from about 28 to 100 times smaller than the nominal diameter of the pipe in the range from 7 mm (0.25") to 152 mm (6"), ratio 28 being attributable to small diameter non-SDR-9 piping, and ratio 100 being attributable to the larger diameter SDR-9 pipe, wherein the protective polymer is coextrudable with the PEX;

(b) an intermediate tubular layer of crosslinked polyethylene (PEX) having a gel level of at least 65% and containing from 0.1% to about 1.75% by weight carbon black, the intermediate tubular layer contiguously disposed radially outward from the core; and,

(c) an oxygen barrier of material other than polyethylene disposed radially outward from said intermediate layer.

15 15. The multiplayer pipe of claim 14 wherein the protective polymer is selected from the group consisting of high density polyethylene ("HDPE") and chlorinated polyethylene ("PE"), the HDPE has a density in the range from 0.941 g/cc to 0.963 g/cc, and the chlorinated PE has a chlorine content in the range from 5 to about 50% by weight.

10 16. A process for producing a multilayer pipe comprising co-extruding:

 (a) an inner relatively thick-walled tubular layer of crosslinked polyethylene (PEX) crosslinkable to a gel content of at least 65% and containing from 0.1% to about 1.75% by weight carbon black; and,

15 (b) an outer tubular layer of PEX free of carbon black, crosslinkable to a gel level content of at least 65%, contiguously disposed radially outward from the inner layer and melt-bonded thereto, wherein the outer tubular layer of PEX is color-coded for installation in a chosen service, and the combined thickness of the inner and outer tubular layers meets specifications of an applicable piping code.

20 17. The process of claim 16, including, extruding an inner tubular core layer of protective polymer having a substantially uniform wall thickness at least 0.025 mm (1 mil) but no more than 1.52 mm (0.060"), the protective polymer being selected from the group consisting of high density polyethylene ("HDPE") and chlorinated polyethylene ("PE") having a maximum wall thickness from
25 about 28 to 100 times smaller than the nominal diameter of pipe in the range from 7 mm (0.25") to 152 mm (6"), ratio 28 being attributable to small diameter non-SDR-9 piping, and ratio 100 being attributable to the larger diameter SDR-9 pipe, wherein the HDPE has a density in the range from 0.941 g/cc to 0.963 g/cc, and the chlorinated PE has a chlorine content in the range from 5 to about 50% by weight.

18. A crosslinked polyethylene composition (PEX) having improved resistance to oxidation and ultraviolet light comprising from 0.1 to less than 2.0 weight percent of carbon black, wherein said crosslinked polyethylene was crosslinked by a method selected from the use of peroxide, addition of AZO compounds and by a silane grafting method.

19. The composition of claim 18 wherein said carbon black is present at a level from 0.1 to 1.75 weight percent.

20. The composition of claim 19 wherein said carbon black is present at a level from about 0.40 to about 1.25 weight percent.

21. A composition of claim 18 wherein said carbon black has a particle size of less than 27 nm.

22. A composition of claim 21 wherein said carbon black has a particle size of less than 22 nm.

23. A composition of claim 22 wherein said carbon black has a particle size of less than 20 nm.

24. A composition of claim 18 wherein said crosslinked polyethylene was crosslinked using the Sioplas method of silane grafting.

25. A composition of claim 24 further comprising at least one antioxidant.